U.S. Patent Application Serial No. **10/518,216**
Preliminary Amendment

REMARKS

Claim 29 has been added in order to more particularly point out, and distinctly claim the subject matter which the Applicants regard as their invention. Support for the new claim is found on page 9, line 28 to page 12, line 10. The Applicants respectfully submit that no new matter has been added. It is believed that this Amendment is fully responsive to the Final Office Action dated **October 23, 2008.**

In the Final Office Action, Claims 1-6 and 8 were rejected under 35 U.S.C.§102(b) as being anticipated by Takada et al. in their publication in the Journal of Sol-Gel Science and Technology, titled "Control of Particle Size Distribution of CdS Quantum Dots in Gel Matrix." Reconsideration and removal of this rejection are respectfully requested in view of the following remarks.

In the Final Office Action, Claim 7 is rejected under 35 U.S.C.§103(a) as being unpatentable over Takada et al. in their publication in the Journal of Sol-Gel Science and Technology, titled "Control of Particle Size Distribution of CdS quantum Dots in Gel Matrix" as applied to Claim 1 above, and further in view of Chia et al. in their publication in SPIE, titled "Cadmium Telluride quantum dot-doped glass by the sol-gel technique". Reconsideration and removal of this rejection is respectfully requested in view of the following remarks.

Regarding the Response to Arguments portion of the Final Office Action, concerning nonlinear optical properties, and the assertion that the nonlinear optical properties mentioned in Takada et al. have nothing to do with the light-traveling direction, the assertion that even if semiconductor superfine particles emit light, testing the nonlinear optical properties thereof does not

require the use of light of the same wavelength as that of the light emitted by the particles, and that the nonlinear optical properties are thus not affected, it is respectfully submitted that:

The refractive index n of a medium with nonlinear optical properties is represented by the following equation (1):

$$n = n_0 + n_2 I \cdots (1),$$

wherein n_0 is the refractive index when the light is weak; I is the intensity of incident light; and n_2 is proportionate to the real number of the third-order nonlinear susceptibility. The equation (1) also represents the Kerr effect mentioned in the Office Action. In general, when the refractive index of a medium changes, the light-traveling direction also changes. Therefore, the equation (1) can also be interpreted as an equation that establishes that light changes its direction of travel based on its intensity.

Explained below is the actual phenomena, referring as examples to the optical bistability and phase conjugation mentioned in Takada et al., as asserted in the Office Action.

With respect to optical bistability, the transmittance changes when the refractive index of a cavity changes. As a result, the intensity of light that passes therethrough also changes.

With respect to phase conjugation, the refractive index of a medium is spatially modulated to form cross stripes. This generates light in a special direction (phase-conjugate light). For instance, in G. I. Stegeman et al., *Appl. Phys. Lett.*, 51, 1682 (1987), II-VI group semiconductor superfine particles (CdS_xSe_{1-x}) dispersed in glass are used as a nonlinear optical medium (Fig. 1).

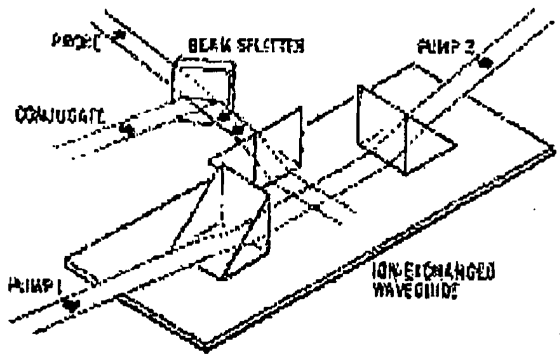

Fig. 1 Experimental setup for conjugate pulse generation (degenerate four-wave mixing) in a planar waveguide, showing location of prism couplers. (*Stegeman et al.*)

In this case, by directing two optical pulses, which are called beams PUMP 1 and PUMP 2, in the presence of the beam PROBE, a new phase-conjugate light called beam "CONJUGATE" is generated.

The size of actual devices is smaller than that shown in its entirety in Fig. 1; thus, the distance of propagation is smaller. When the medium emits light, the light is emitted in various directions from the nonlinear optical medium. In this case, it is difficult to separate the beam CONJUGATE and the beams emitted from the nonlinear optical medium. The use of beams with different phases does nothing to solve the problem.

As described above, the nonlinear optical properties disclosed in Takada et al. are very difficult to measure when the medium emits light. Specifically, it is believed that Takada et al. uses a material that emits minimal light.

Regarding fluorescence quantum yield, in order to impart a fluorescence quantum yield of 3% or greater to semiconductor superfine particles, covering the surface of the semiconductor superfine particles by a protective material is indispensable. The present invention uses a surfactant

as such a protective material.

In Takada et al., on the other hand, all of the samples of semiconductor superfine particles are grown in glass to a size of about 2 to about 7nm. The growth of semiconductor superfine particles in glass requires heat treatment at high temperatures. In practice, in Takada et al., heat treatment is performed for 16 hours at 420°C (Fig. 2, etc., of Takada et al.). This causes the solidification of the glass, which was initially a sol, and the simultaneous growth of semiconductor superfine particles. In Takada et al., in addition to TEOS, APS is added as an alkoxide used in the sol-gel process. In Takada et al., APS is used to disperse semiconductor superfine particles in the gel (Abstract, etc.)

It is believed that, in Takada et al., the effect of APS only lasts until the "Dried Gel" stage shown in Fig. 2 of Takada et al. This is because in the subsequent heat treatment at 420°C, the organic components and hydrogen contained in the APS are combusted and substantially destroyed. This is detailed below.

For instance. Fig. 2 below of Brinker et al., *J.Non-Cryst. Solids*, 72 345 (1985) shows the organic components in glasses produced by sol-gel reactions.

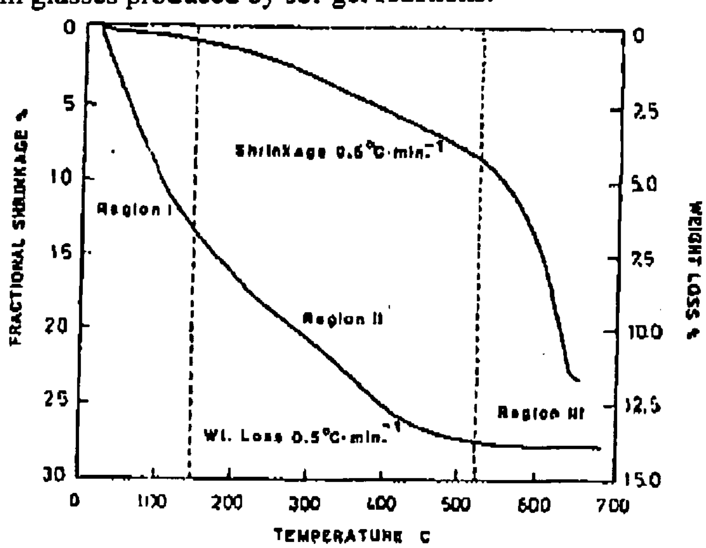

Fig. 2. Linear shrinkage and weight loss measured at 0.5°C/min. (Brinker *et al.*)

In Fig. 2, attention is given to the right axis, which represents Weight Loss (%) (the lower curve). In Brinker et al., the gels prepared by the sol-gel process are heated at a rate of 0.5°C/min in flowing desiccated air, and changes in weight are measured. According to Fig. 2, the change in weight diminishes at around 400°C, and nearly stabilizes at a fixed value at 600°C. This shows that, at around 400°C, most of the organic components have been combusted. In the experiments of Brinker et al., about 13 hours were required until the temperature reached 400°C.

There is a great deal more literature confirming, as in the above case, the combustion of organic components at about 300 to about 400°C.

In Takada et al., the dried gels are heat treated for 16 hours at 420°C with flowing oxygen; therefore, it is believed that the organic components have been almost completely combusted. Specifically, in Takada et al., there is nothing that remains to act as a protective material, such as a surfactant.

It is noted that, as a result of the step of heat-treatment at 420°C, the CdO fine particles grow and a glass network develops, anchoring the CdO fine particles in the glass. As a result, it becomes impossible to introduce a protective material after this step.

As described above, since there is nothing that protects the surface of the semiconductor superfine particles, the fluorescence quantum yield in Takada et al. is believed to be less than 3%.

In Chia et al., heat treatment is performed for 6 to 12 hours at 540 to 570° C (Abstract, etc.). Therefore, as in Takada et al., it is believed that organic components such as APTES and the like have been combusted, and that thus, the fluorescence quantum yield is less than 3%.

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Thus, it is respectfully submitted that the present claimed invention i; distinct from and non-obvious in view of Takada et al. and Chia et al.

In view of the above remarks, removal of the rejections is respectfi lly requested.

In view of the accompanying remarks, Claims 1-8 and 29 are believed to be in condition for further examination and to be allowable.

In the event that this paper is not timely filed, the Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No.)1-2340.

Respectfully submitted,

KRATZ, QUINTOS & HANSON, LLP

James N. Baker
Agent for Applicant
Reg. No. 40,899

JNB/ak

Atty. Docket No. **080308**
Suite 400
1420 K Street, N.W.
Washington, D.C. 20005
(202) 659-2930

23850
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